Space Weather Technical Forecast

Issued on Tuesday 11 February 2025 at 01:16 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares (R1-R2 Blackouts) likely. Chance of G1/Minor throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with only slight C-class flares in the last 24 hours. There are currently eight sunspots on the Earth-facing disc. AR3981, which has been the most active region in recent times is currently rotating off the northwest disc, with analysis becoming increasingly difficult. Recent imagery still shows some bright magnetic looping suggesting an ongoing flare potential, however this risk will recede as this moves over the limb through Day 1 (11 Feb). The other regions across the disc are mostly smaller and simpler, however AR3990 in the southeast disc has the potential for further complexity to become visible as this moves into a less oblique viewing angle.

No Earth directed Coronal Mass Ejections (CMEs) were observed from available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as measured by ACE at L1 showed elevated wind speeds due to a connection to the high speed stream from CH13/-, averaging between 550-580 km/s. Density was below average throughout. Interplanetary Magnetic Field, Bt, was steady, staying largely weak, between 6-8nT. The north-south component, Bz, was also weak and mainly negative (southwards-directed) with brief positive intervals, ranging between -7nT to +7nT. The Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Unsettled to Active (Kp3-4), with a G1/Minor Storms interval observed between 10/0000-0300 UTC, although this were initially reported as Active.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 remained at background. High energy electron flux (greater than 2MeV) at GOES16 was at mostly background with a brief peak of 658 pppc at 10/1900 UTC. The associated 24-hour fluence persisted below the Active threshold, recording 1.01e7 integrated pfu at 11/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is likely with isolated M-class flares and a very slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: There is a slight chance of two glancing CMEs during the start of Day 1 (11 Feb). A third slow CME left the Sun around 08/0930 UTC in association with the M2.0 flare from AR3981. This is considered most likely to miss, passing ahead of Earth, but cannot

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be completely ruled out for a glancing enhancement on Day 3 (13 Feb). Otherwise ongoing fast wind influence from CH13/- is expected, before transitioning into the fast wind from CH14/- on Days 2-3 (12-13 Feb). Unsettled to Active geomagnetic activity is forecast with G1 Minor Storms likely and a slight chance G2 Moderate Storm from any CME arrival Day 1 (11 Feb), and an ongoing chance of G1 Minor Storms Day 2-4 (12-14 Feb).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is forecast to persist at background with only a slight chance of rising due to any notable flares from AR3981 in the northwest. High energy electron flux observed at GOES16 is expected to see a gradual rising trend later in the period, with an increasing chance of periods of High flux. The associated 24 hour fluence is currently expected to remain below Active, but with a likely rising trend.

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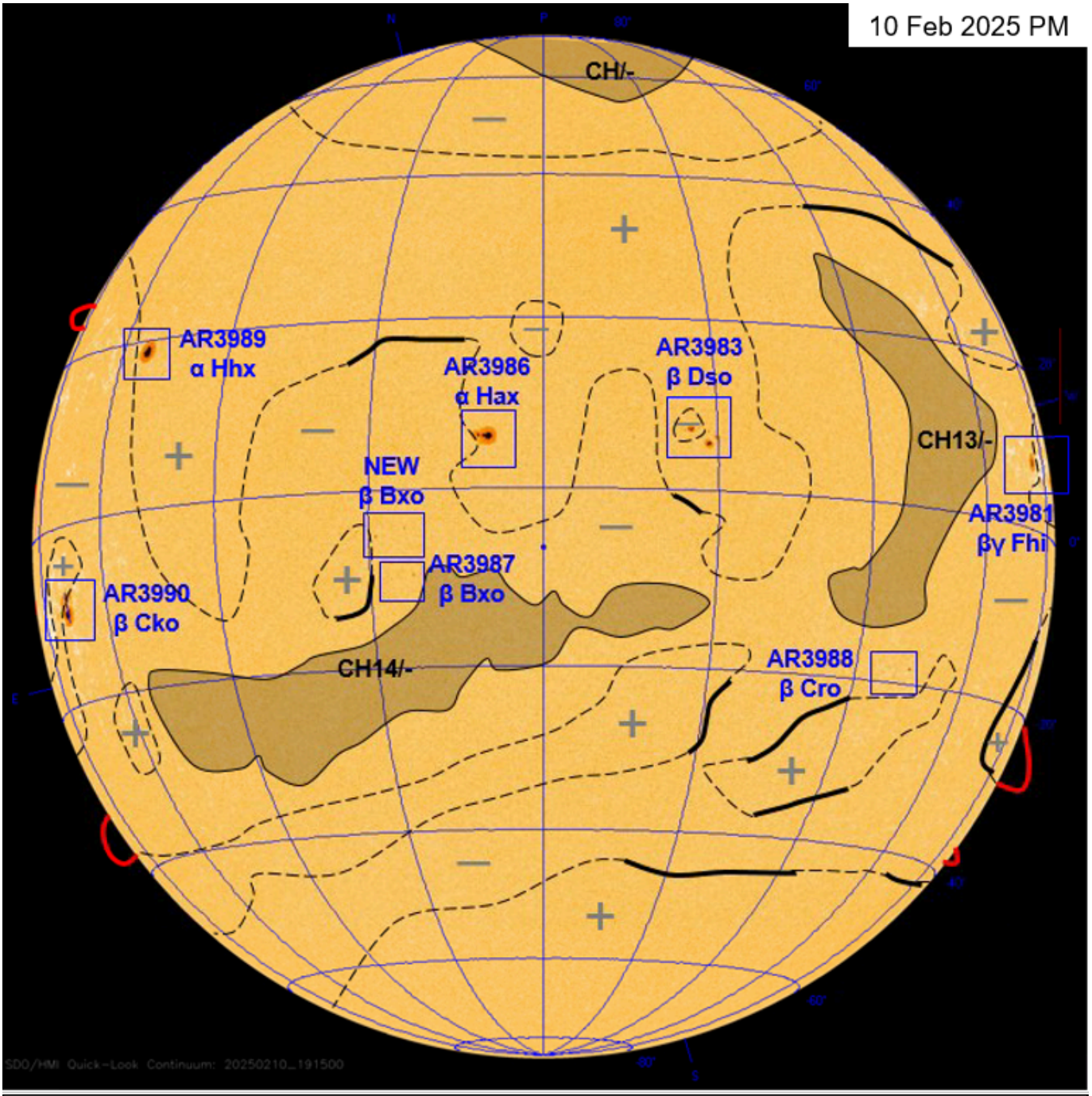
Figure 1: Solar Synoptic Map valid 10/1945 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There is a slight chance of up to two glancing blows from faint CMEs associated with two M7 flares on 06/07 Feb, which may arrive at Earth in the early hours of Day 1 (11 Feb). A third slow CME left the Sun around 08/0930 UTC in association with the M2.0 flare from AR3981. This is considered most likely to miss, passing ahead of Earth, but cannot be completely ruled out for a glancing enhancement on Day 3 (13 Feb).

Ongoing fast winds from CH13/- are expected to continue through Day 1 (11 Feb), perhaps with a slightly declining trend into Day 2 (12 Feb) to elevated or perhaps even slightly elevated solar wind speeds. The next enhancement is then expected later Day 2 or into Day 3 (12/13 Feb) from a connection to the high speed stream from CH14/-. This is an elongated feature across a similar latitude to Earths current heliographic projection, but has seen its western extent reduced in size compared to previous rotation. Any subsequent enhancement from this feature is low confidence in terms of the timing of onset, but is likely to become Elevated to Strong (500-600km/s) by the end of the period. This is largely supported by MOSWOC Enlil with persistent solar winds of around 550-600km/s from later on day 2 (11 Feb), albeit with a slightly early onset.

Quiet to Active (Kp 2-4) geomagnetic activity is expected through the period due to ongoing slightly elevated to elevated solar winds. G1/Minor storm (Kp 5) intervals are likely at first, with a slight chance of G2/Moderate storm intervals (Kp 6) if any CME influence is observed. There is also an ongoing chance of G1 Minor storms Days 2-4 (12-14 Feb) from any further fast wind enhancement or CME glance, most likely if they give a combine influence, however this is low confidence.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	60	50	50	50
Strong	**G3**	No	5	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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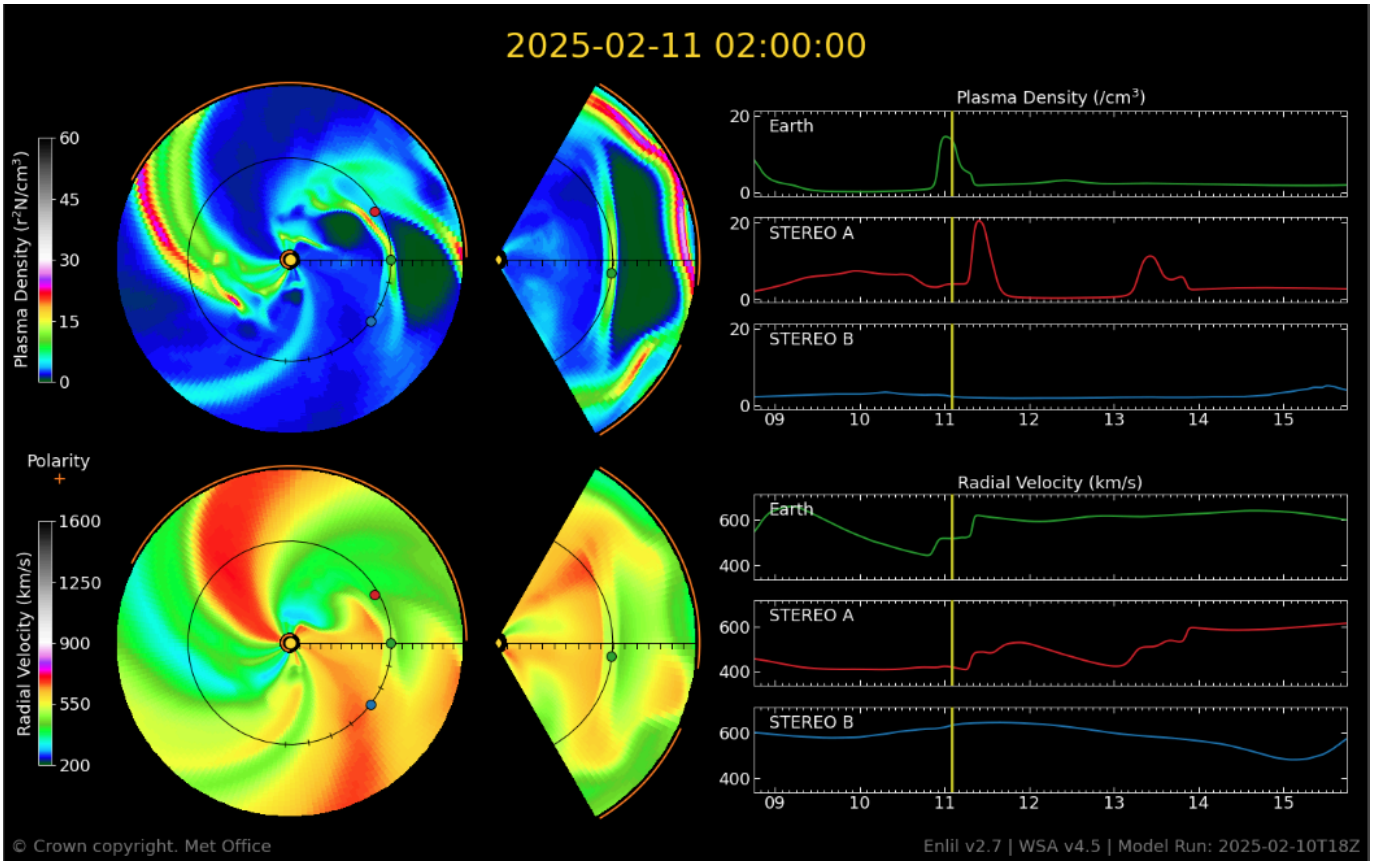
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
07/0200	Partial	AR3981	NW	300	10/2100 +/-12 hours	Low confidence.
07/2100	Partial	AR3981	NW	300	11/0000 +/-12 hours	Low confidence.

Figure 2: MOSWOC Enlil output showing the potential for a CME early on 11 Feb, followed by a subsequent HSS from CH14/-.



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Radio Blackouts - X-Ray Flares

Moderate activity is likely with isolated M-flares and an ongoing slight chance of isolated X-class flares. These are initially most likely from AR3981 in the northwest disc, followed by the new region in the southeast which has now been numbered AR3990.

AR3981, which has been the most active region in recent times is currently rotating off the northwest disc, with analysis becoming increasingly difficult. There is some bright magnetic looping evident above the spot in e.g. SDO aia-94, suggesting an ongoing flare potential, however this risk will recede as this moves over the limb through Day 1 (11 Feb). The other regions across the disc are mostly smaller and simpler, however AR3990 in the southeast disc has the potential for further complexity to become visible as this moves into a less oblique viewing angle.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	60	60	60	60
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: X-ray trace from GOES16&18 over the last 24 hours.

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Solar Radiation Storms (High Energy Protons)

GOES-16 proton flux is forecast to persist at background with only a very slight chance of enhancement from any notable flares. This is most likely from AR3981 in the northwest, along with the other sunspots that previously rotated over the limb, however this has shown some sign of simplification in the last few days limiting this potential.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been Background to Moderate and expected to continue mostly at this level. The arrival of the High Speed stream (HSS) from CH13/-, is likely to give an eventual response in the observed flux, due to charging of the outer Van-Allen belt. Possible CME arrivals, along with a further enhancement from CH14/- complicate this picture, perhaps limiting any potential rise until later in this period. This brings an increasing likelihood of periods of High flux at diurnal peak from Day 2 (11 Feb)

The corresponding 24-hour fluence is expected to be below the Active threshold, but with a rising trend probable. While this is supported by MOSWOC REFM, this is perhaps under-forecasting the potential rise later in the period.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	5	10	10	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM output showing a rising trend for the 24 hour electron fluence, but staying below the active threshold.

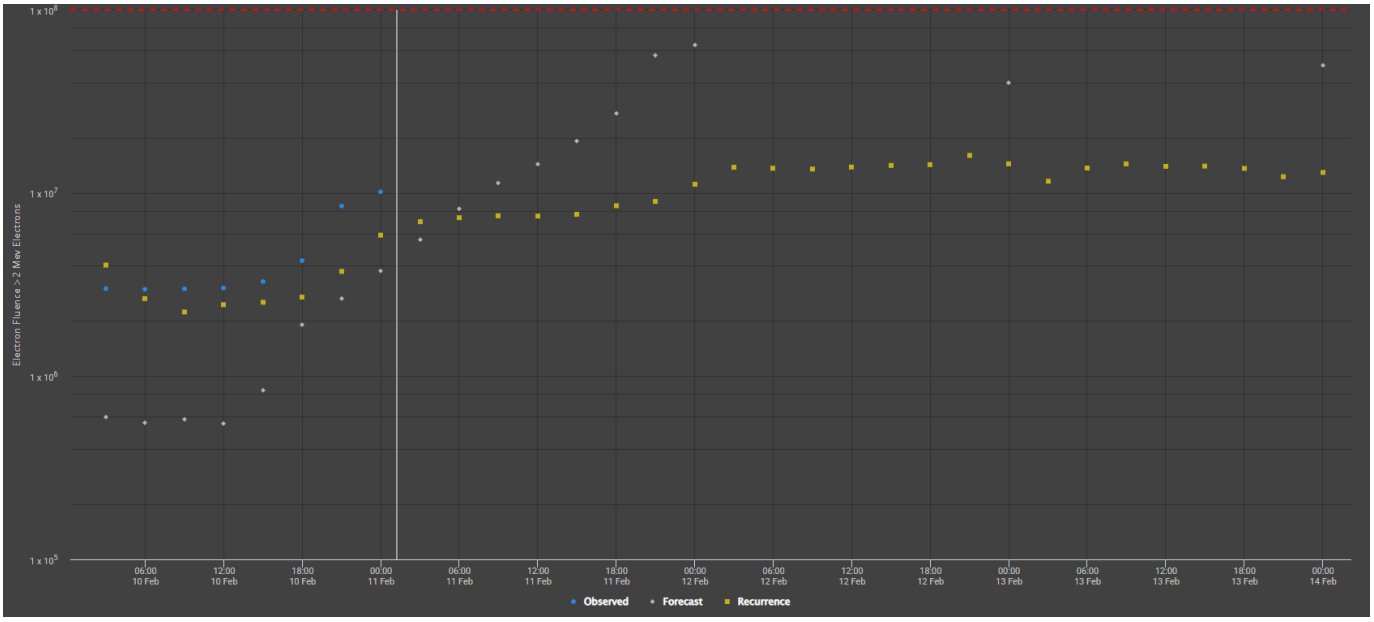

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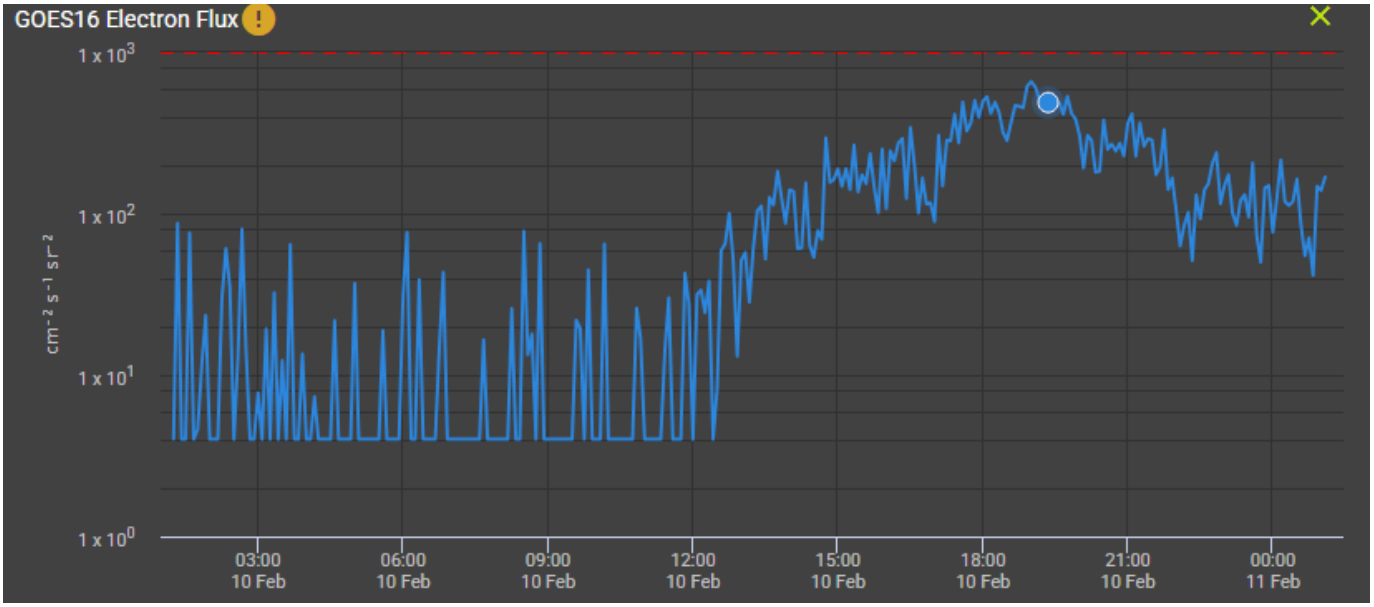
Figure 5: GOES16 electron flux showing a diurnal rise.



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